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G1F F1H

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EP 0745965 A1 EP 0657857 A1 EP 0543543 A1
US 5467283 A US 5162794 A
WPIL Accession No.96-016564 & JP 7291065 A (SUZUKI) 07.11.95 (see abstract)

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UK CL (Edition O) G1F
INT CL[6] G01C 21/20 , G08G 1/0968 1/0969 1/16
On-line : WPIL

(54) Collision warning by path prediction of a vehicle

(57) A method for guiding a driver by predicting the progress path of a car is disclosed in which it is possible to inform a driver of the progress direction of a car by anticipating collision of the car with its surrounding objects in the case that a car progresses at the directional angle of the present car. The method for guiding a driver by predicting the progress path of a car comprises the steps of; (a) retrieving the present position of a car and the position of its surrounding objects 51,52,53; (b) retrieving the present directional angle of the car; (c) displaying the progress trace of the car by predicting the cars progress at the present directional angle at the present position of the car. Furthermore, a driver can predict the danger of collision in the case that a driver drives a car on a narrow road or at the place where many obstacles are scattered, thereby preventing traffic accidents. The method also includes determining the shortest distance FM, BM between the car and surrounding objects and determining whether the shortest distance is greater than a critical distance.

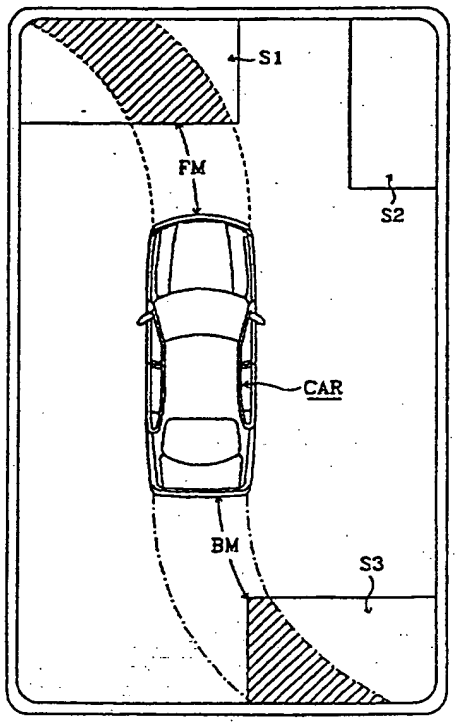

FIG. 4

GB 2 320 326 A

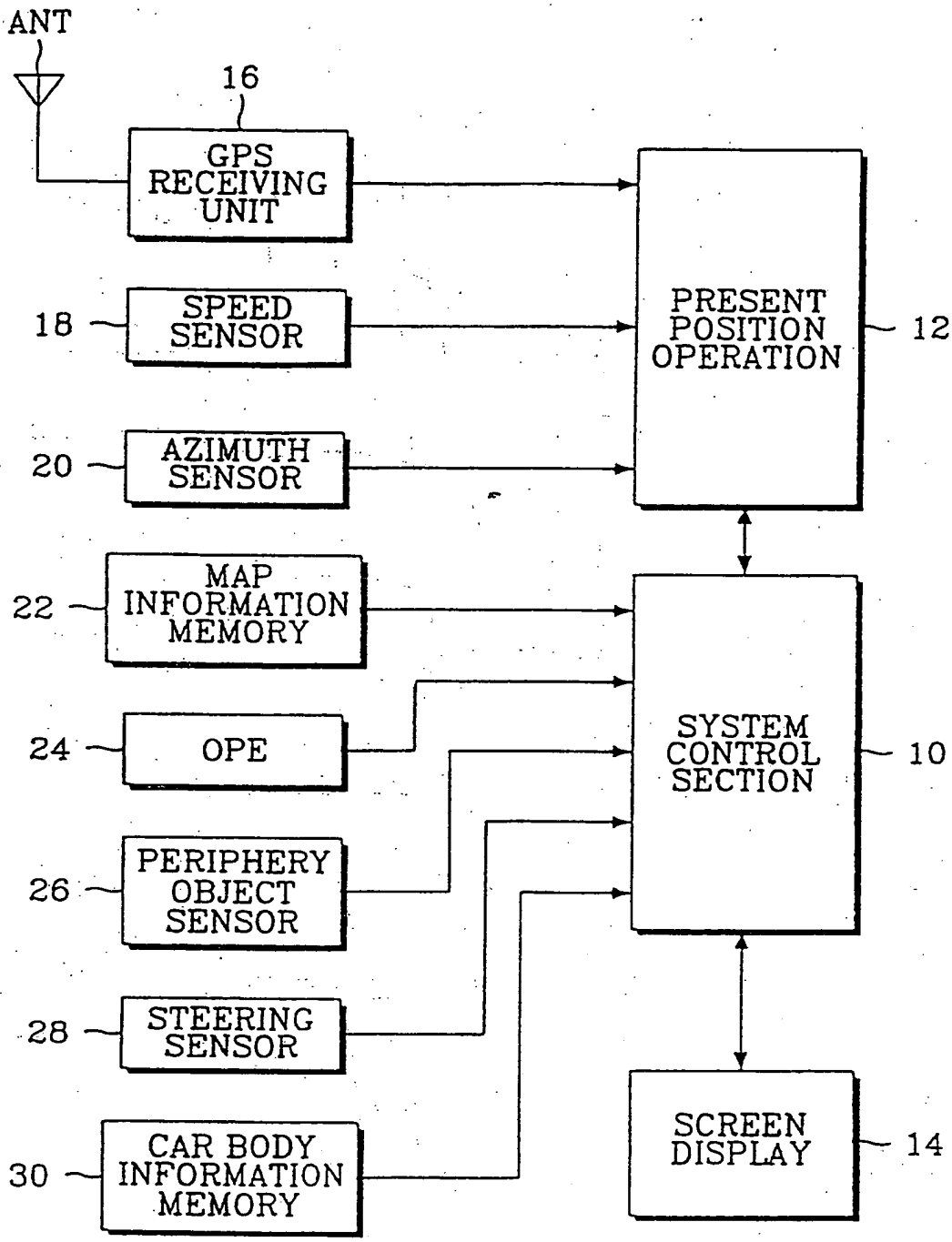
ANT
16
GPS RECEIVING UNIT
18
SPEED SENSOR
20
AZIMUTH SENSOR
22
MAP INFORMATION MEMORY
24
OPE
26
PERIPHERY OBJECT SENSOR
28
STEERING SENSOR
30
CAR BODY INFORMATION MEMORY
PRESENT POSITION OPERATION
12
SYSTEM CONTROL SECTION
10
SCREEN DISPLAY
14

FIG. 1

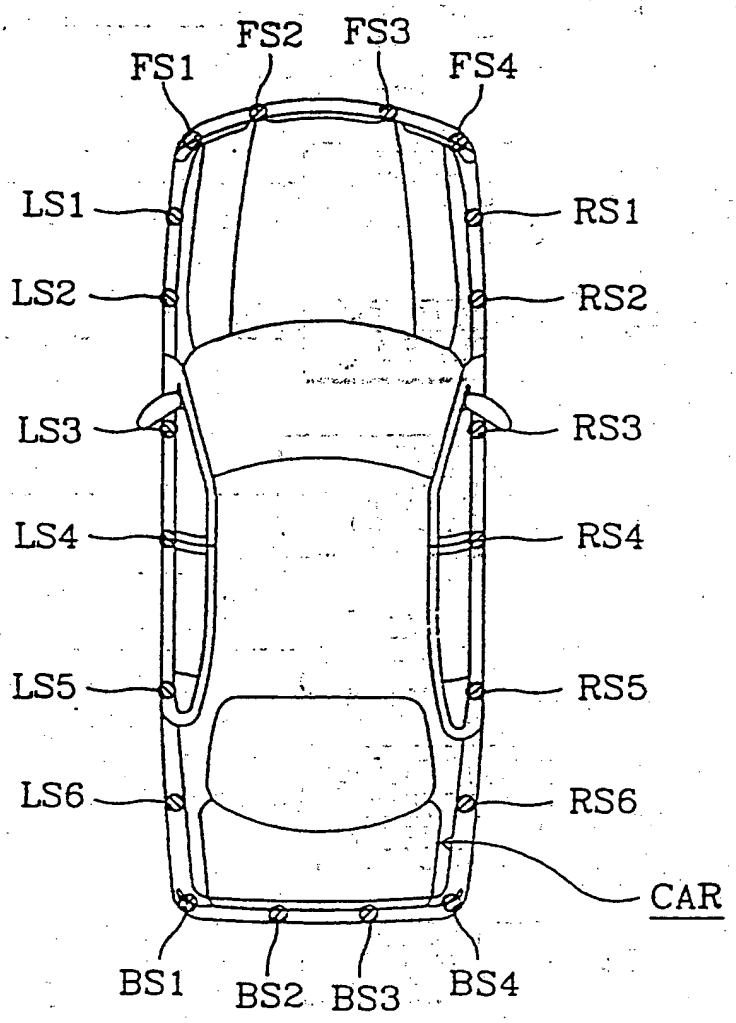
FS1
FS2
FS3
FS4
LS1
LS2
LS3
LS4
LS5
LS6
RS1
RS2
RS3
RS4
RS5
RS6
CAR
BS1
BS2
BS3
BS4

FIG. 2

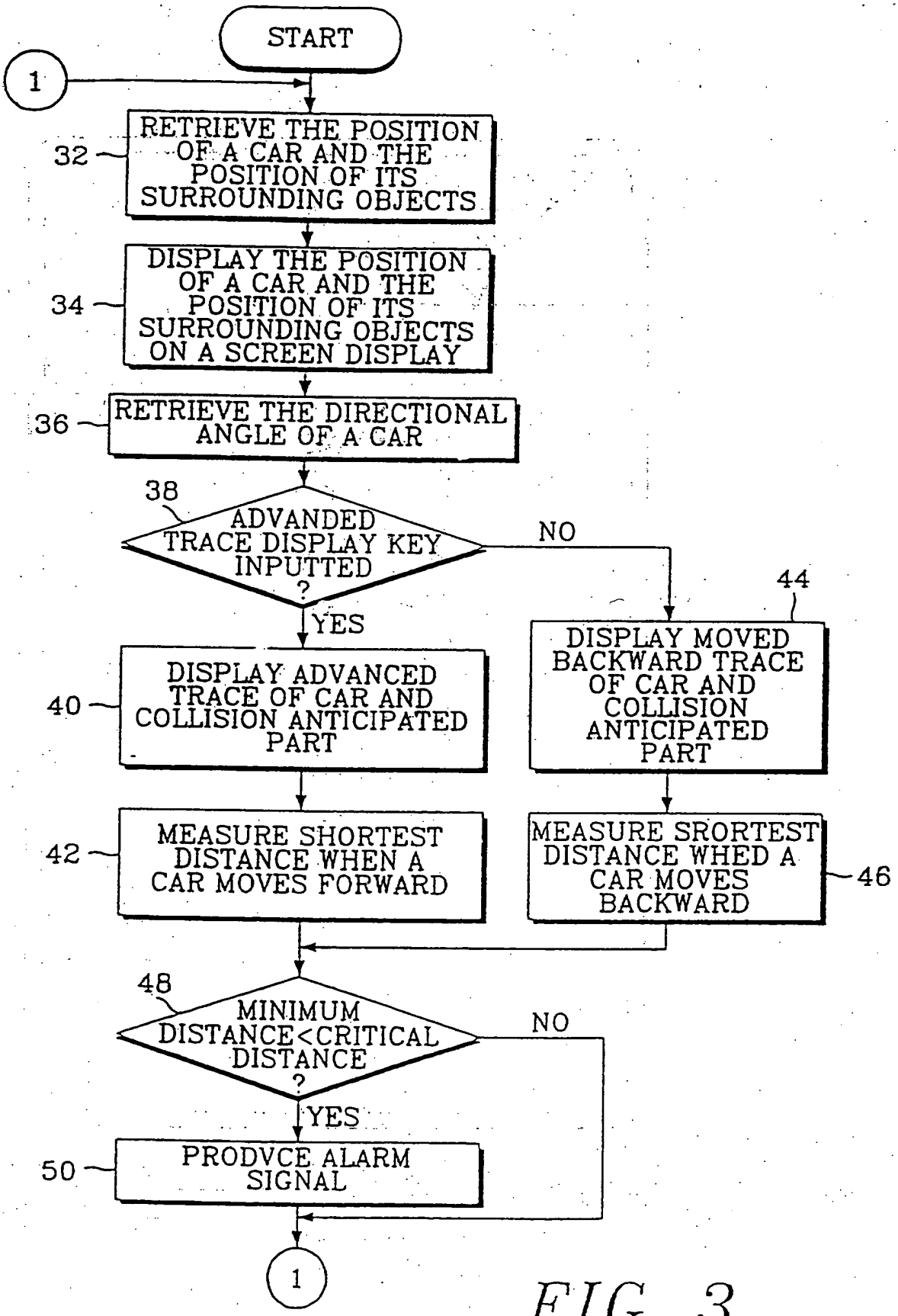
START
1
RETRIEVE THE POSITION OF A CAR AND THE POSITION OF ITS SURROUNDING OBJECTS
32
DISPLAY THE POSITION OF A CAR AND THE POSITION OF ITS SURROUNDING OBJECTS ON A SCREEN DISPLAY
34
RETRIEVE THE DIRECTIONAL ANGLE OF A CAR
36
38
ADVANDED TRACE DISPLAY KEY INPUTTED ?
NO
YES
44
DISPLAY MOVED BACKWARD TRACE OF CAR AND COLLISION ANTICIPATED PART
DISPLAY ADVANCED TRACE OF CAR AND COLLISION ANTICIPATED PART
40
MEASURE SHORTEST DISTANCE WHEN A CAR MOVES FORWARD
42
MEASURE SRORTEST DISTANCE WHED A CAR MOVES BACKWARD
46
48
MINIMUM DISTANCE<CRITICAL DISTANCE ?
NO
YES
PRODVCE ALARM SIGNAL
50
1

FIG. 3

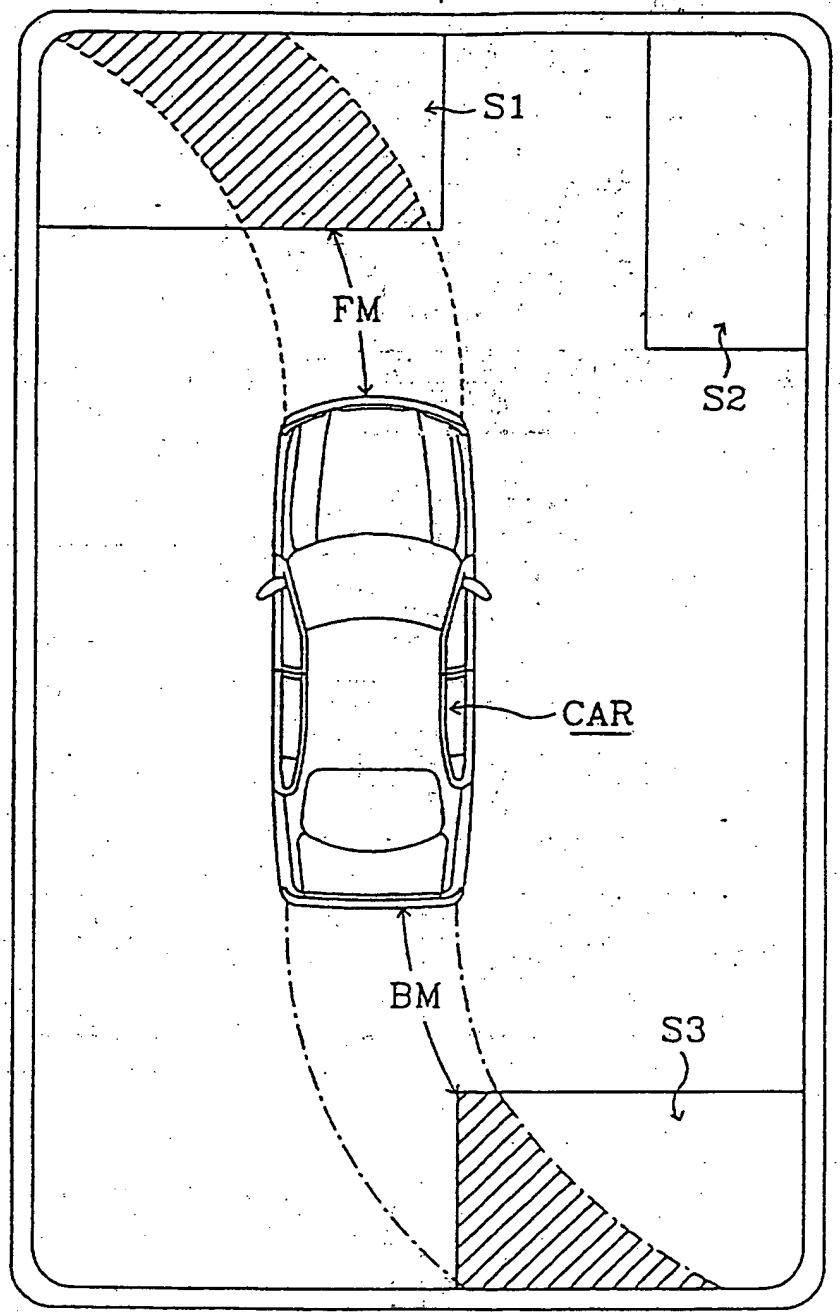

FIG. 4

connection with its surrounding objects in the case that a car progresses. That is to say, where a car moves forwards or backwards a driver is not alerted to whether or not the car is likely to collide with an adjacent object.

Accordingly, a driver had to judge for himself in which direction to drive his car on the basis of the present directional angle and present position of the car. The directional or steering angle is grasped easily when a driver is actually driving his car but the directional angle is not grasped easily in the case of a stationary car. In addition, in the case where a car is reversing, even though a driver may grasp the present directional angle, it is far more difficult for a driver to judge the direction in which the car will progress, compared with when a car moves forward.

In the conventional navigation equipment and its method for displaying surroundings of cars, there has been an inconvenience that since only information on the present position of a car and its surroundings is provided for a driver, he must judge for himself the connection the car has with surrounding objects.

It is therefore an aim of embodiments of the present invention to provide a method for guiding a driver by predicting the progress path of a car, in which it is possible to inform a driver of the progress direction of a car by anticipating the connection the car will have with its surrounding objects on the basis that the car progresses at its current directional angle.

According to a first aspect of the invention, there is provided a method for guiding a driver by predicting

the progress of a car, comprising the steps of; (a) retrieving the present position of a car and the position of its surrounding objects; (b) retrieving the present directional angle of said car; and (c) displaying an anticipated progress trace of said car on the basis that the car will progress at its present directional angle from the present position of said car.

Preferably, the method further comprises a step of displaying a collision anticipated part in which the anticipated progress trace of a car and its surrounding objects are overlapped after displaying the progress trace of said car.

The method may further comprise the steps of; measuring the shortest distance between a car and its surrounding object along said progress trace; and producing alarm signal if said shortest distance is smaller than a critical distance which there is a danger of collision.

Preferably, said step of displaying the progress trace comprises the steps of: displaying an advanced, i.e. forward, trace on a screen display if the gear of a car is in a position for moving forward; and displaying a moved backward, i.e. reverse, trace on a screen display if said gear is in the position for moving backward.

Said step of displaying the progress trace may comprise the steps of: displaying an advanced trace on a screen display if an advanced trace display key is inputted by a user; and displaying a moved backward trace on a screen display if a moved backward trace display key is inputted by a user.

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a block diagram showing the construction of a navigation device for guiding a driver by predicting the progress of vehicles according to a preferred embodiment of the present invention;

Figure 2 is a schematic plan view showing an example of a car equipped with a plurality of sensors for censoring its surrounding objects according to an embodiment of the present invention;

Figure 3 is a flowchart showing a process routine of a method for guiding a driver by predicting the progress of a car according to a preferred embodiment of the present invention;

Figure 4 is a schematic view showing an example of guiding a driver by predicting the progress path of a car according to an embodiment of the present invention.

Now, a preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings. Throughout the drawings, it is noted that the same reference numerals or letters will be used to designate like or equivalent elements having the same function. In the following description, numeral specific details are set forth to provide a more through understanding of the present invention. It will be apparent, however, to one skilled in the art that the invention may be practised without their specific details. The detailed descriptions on known function and

constructions unnecessarily obscuring the subject matter of the present invention will be avoided hereinafter.

Figure 1 is a block diagram showing the inner construction of navigation apparatus for guiding a driver by predicting the progress of vehicles according to a preferred embodiment of the present invention.

In Figure 1, a GPS receiver 16 receives the position information transmitted from a plurality of satellites through an antenna ANT and provides a present position operating section 12 with the position information produced by estimating the value of quasi-coordinates of the present position. A speed sensor 18 provides the present position operating section 12 with the speed information of a pulse or voltage form after sensing the speed of a car. An azimuth sensor 20 provides the present position operating section 12 with the present position information of a pulse or voltage form for the present progress direction of a car.

The present position operating section 12 receives the position information from the GPS receiver 16, the speed information from the speed sensor 18 and the information on the progress direction of a car from the azimuth sensor 20 to operate and retrieve the present position information of a car.

A map information memory 22 stores map information and other additional information and outputs the map information to a system control section 10 when the system control section 10 demands the map information. A manipulating section 24 having a plurality of keys interfaces the system control section 10. A surrounding objects sensing sensor 26 measures the distance to a

surrounding object by transmitting a beam of light, a radio wave or a sound wave to a surrounding object such as an infrared ray sensor etc. and detecting the transmitted beam.

Referring to Figure 2, there is shown an example of a car equipped with the surrounding objects sensing sensor 26. A car shown in Figure 2 is equipped with a plurality of surrounding objects sensing sensors 26 for precisely sensing surrounding objects of the car. Forward sensor FS1-FS4 senses the objects located in front of a car and backward sensor BS1-BS4 senses the objects located at the back of a car. Also, rightward sensor RS1-RS6 senses the objects located at the right side of a car and leftward sensor LS1-LS64 senses the objects located at the left side of a car.

As described above, a car is equipped with a plurality of surrounding objects sensing sensors 26, so that a driver can sense precisely any objects in all directions. A steering sensor 28 in Figure 1 senses the directional angle of the front wheels of a car by sensing through an encoder etc. the number of revolutions of a steering handle or a steering system connected to the front wheel of a car. A car body information memory 30 stores the length of a car and the width thereof etc. and outputs the car body information to the system control section 10 when the system control section 10 demands the car body information.

The system control section 10 of the navigation equipment performs mainly navigation function and grasps the position of the obstacles around a car after receiving the surrounding objects sensing signal from the surrounding objects sensing sensors 26. In addition, the

system control section 10 calculates the direction of progress of the car after receiving the present steering sensing signal of a car from the steering sensor 28, predicts the progression path of the car based on the car body information and the progress direction by reading the car body information like the length of a car and the width thereof etc. from the car body information memory 30, and outputs a resultant display information produced to display the progress path to a screen display 14.

The screen display 14 displays a navigation screen, surrounding objects or the progress path of the car under the control of the system control section 10.

Figure 3 is a flowchart showing a process routine of a method for guiding the driver by predicting the progress path of a car using the above navigation equipment according to a preferred embodiment of the present invention. The process routine shown in Figure 3 is executed when key inputs commanding the performance of parking guide are entered using the manipulating section 24 by a driver. At step 32, a system control section 10 retrieves the position of a car and the position of its surrounding objects. The retrieval of the position of a car can be carried out since the present position operating section 12 provides the system control section 10 with the present position information. Also, The retrieval of the position of surrounding objects of a car can be carried out since the surrounding objects sensing sensors 26 provide the system control section 10 with the surrounding objects sensing signal sensing the distance to the surrounding objects in all the directions around the car. If the retrieval of the present position of a car and the position of its surrounding objects is executed at step 32, the program proceeds to step 34 at which the

system control section 10 displays the position of a car and the position of its surrounding objects on the screen display 14. If the displaying operation is executed at step 34, the system control section 10 retrieves the directional angle of the car at step 36. The retrieval of the directional angle of a car can be carried out by retrieving the present steering sensing signal of the steering sensor 28 mounted on a steering wheel or handle. If the directional angle of the car is retrieved by retrieving the present steering sensing signal, the program proceeds to step 38 at which it is determined by the system control section 10 whether or not a trace of the car moving forward is to be displayed. At this time, a driver inputs an advanced trace display key of the manipulating section 24 so that the system control section 10 can permit the screen display 14 to display the advanced trace of a car. If an advanced trace display key is inputted by a user at step 38, the program proceeds to step 40 at which the system control section 10 generates data for displaying the advanced trace of a car based on the directional angle and provides the screen display 14 with the data for displaying the advanced trace and the data for displaying a collision anticipated part, i.e. the part at which the advanced trace representing a projected forward path of a car overlaps with a detected surrounding object. The screen display 14 displays the advanced trace of a car and the collision anticipated part based on the data for displaying the advanced trace and the data for displaying a collision anticipated part. On the other hand, if an advanced trace display key is not inputted by a user at step 38, the program proceeds to step 44 at which the system control section 10 generates data for displaying the moved backward trace of a car based on the directional angle and provides the screen display 14 with the data for displaying the moved backward trace and the

data for displaying a collision anticipated part, i.e. the part at which the backward trace representing a projected reversing path of a car overlaps with a detected surrounding object. The screen display 14 displays the moved backward trace of a car and the collision anticipated part based on the data for displaying the moved backward trace and the data for displaying a collision anticipated part.

Now, an explanation on the displaying operation will be in detail given with reference to Figure 4 showing the display of the anticipated trace of a car on a screen display 14.

First, the screen display 14 displays the present position of a car CAR and the position of its surrounding objects S1-S3. In Figure 4, the car CAR is displayed in the middle of the screen and the surrounding objects S1-S3 sensed by the surrounding objects sensing sensors 26 are displayed in the edge portion of the screen. If a driver inputs an advanced trace display key under the above situation, the screen display 14 displays the advanced trace shown in dotted line at step 40. Although the advanced trace has been shown in dotted line in Figure 4, the advanced trace may be shown in other colored line or side or other pattern. The overlapped part of the advanced trace of a car and its surrounding object S1 is a collision anticipated part. The collision anticipated part may be also shown in other color or pattern. On the other hand, if a driver inputs an moved backward trace display key, the screen display 14 displays the moved backward trace shown in one dotted solid line at step 42. Although the moved backward trace has been shown in one dotted solid line in Figure 4, the moved backward trace may be shown in other colored line or side or other pattern. The

overlapped part of the moved backward trace of a car and its surrounding object S3 is a collision anticipated part. The collision anticipated part may be also shown in other color or pattern. The overlapped part means that a car CAR can collide against its surrounding object S3 when the car CAR moves backward.

If the displaying operation of the advanced trace and the collision anticipated part has been completed at step 40, the program proceeds to step 42 at which the system control section 10 measures the shortest distance between a car and its surrounding object when a car moves forward along the advanced trace. Namely, in Figure 4, the shortest distance between a car CAR and its surrounding object S1 is FM. If the measurement of the shortest distance between a car and its surrounding object has been completed at step 42, the system control section 10 executes the process routine of step 48.

On the other hand, if the displaying operation of the moved backward trace and the collision anticipated part has been completed at step 44, the program proceeds to step 46 at which the system control section 10 measures the shortest distance between a car and its surrounding object when a car moves backward along the moved backward trace. Namely, in Figure 4, the shortest distance between a car CAR and its surrounding object S3 is BM. If the measurement of the shortest distance between a car and its surrounding object has been completed at step 46, the system control section 10 executes the process routine of step 48.

At step 48, it is determined by the system control section 10 whether the shortest distance is greater than a critical distance or not. At this time, the critical

distance is a minimum distance at which there will be no danger of a collision although a car approaches its surrounding object. That is to say, if the shortest distance is smaller than the minimum distance, there is a possibility that a car collides against its surrounding object.

If it is determined at step 48 that the shortest distance is smaller than the critical distance, the program proceeds to step 50 at which the system control section 10 produces alarm signal. The alarm signal informs a driver that a car may collide with its surrounding object. If the generation of the alarm signal has been completed, the program proceeds back to step 32. Also, if it is determined at step 48 that the shortest distance is greater than the critical distance, the program proceeds back to step 32.

Meanwhile, a driver inputs an advanced or moved backward trace display key so that the advanced or moved backward trace can be displayed on the screen display 14 at step 38. However, the advanced trace may be displayed on the screen display 14 if the gear is in the position for moving forward and the moved backward trace may be displayed on the screen display 14 if the gear is in the position for moving backward after mounting a sensor for sensing the position of a gear on the gear change mechanism or in the gearbox.

As described above, the present invention provides a driver with more convenient driving environment since it is possible to inform a driver of the progress direction of a car by anticipating the connection a car has with its surroundings in the case that a car progresses at a present directional angle. Furthermore, a driver can

predict the danger of collision in the case that a driver drives a car on a narrow road or at the place where many obstacles are scattered, thereby preventing traffic accidents.

While there have been illustrated and described what are considered to be preferred embodiments of the present invention, it will be understood by those skilled in the art that various change and modifications and equivalents may be substituted for elements thereof without departing from the true scope of the present invention. Therefore, it is intended that the present invention not be limited to the particular embodiments disclosed as the best mode contemplated for carrying out the present invention, but that the present invention includes all embodiments falling within the scope of the appended claims.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly

stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. A method for guiding a driver by predicting the progress of a car, comprising the steps of;

(a) retrieving the present position of a car and the position of its surrounding objects;

(b) retrieving the present directional angle of said car; and

(c) displaying an anticipated progress trace of said car on the basis that the car will progress at its present directional angle from the present position of said car.

2. The method according to claim 1, wherein the method further comprises a step of displaying a collision anticipated part in which the anticipated progress trace of a car and its surrounding objects are overlapped after displaying the progress trace of said car.

3. The method according to claim 1, wherein the method further comprises the steps of;

measuring the shortest distance between a car and its surrounding object along said progress trace; and

producing alarm signal if said shortest distance is smaller than a critical distance which there is a danger of collision.

4. The method according to claim 1, wherein said step of displaying the progress trace comprises the steps of:

displaying an advanced, i.e. forward, trace on a screen display if the gear of a car is in a position for moving forward; and

displaying a moved backward, i.e. reverse, trace on a screen display if said gear is in the position for moving backward.

5. The method according to claim 1, wherein said step of displaying the progress trace comprises the steps of:

displaying an advanced trace on a screen display if an advanced trace display key is inputted by a user; and

displaying a moved backward trace on a screen display if a moved backward trace display key is inputted by a user.

6. A method substantially as herein described with reference to the accompanying drawings.

The Patent Office

17

Application No: GB 9713314.4 **Examiner:** Michael Walker
Claims searched: ALL **Date of search:** 17 September 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G1F

Int Cl (Ed.6): G01C 21/20; G08G 1/0968, 1/0969, 1/16

Other: On-line : WPIL

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X,Y	EP 0745965 A1	(K K EQUOS) eg. cols.3,4	X:1 Y:2,3
Y	EP 0657857 A1	(MAZDA) p.5,ll.7 etc.	1,2
Y	EP 0543543 A1	(SUMITOMO) eg. Col.5,ll.1-45	1
Y	US 5467283	(BUTSUEN et al.) whole document	1,3
Y	US 5162794	(SEITH) eg.col.5,l.58 to col.6,l.32	3
Y	WPIL Accession No.96-016564 & JP 7291065 A (SUZUKI) 07.11.95 (see abstract)		1

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